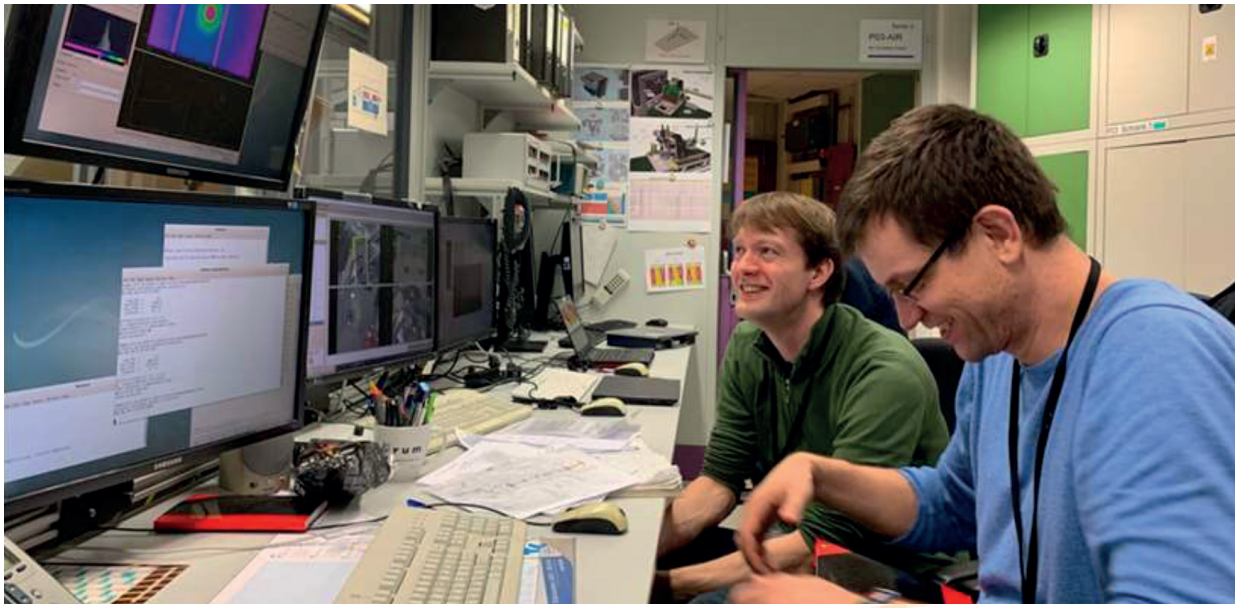

Dr. Erik Brok and Dr. Martin Schmiele from Niels Bohr Institute evaluating data at Petra III.

Using synchrotron X-ray scattering to characterize and optimize polymer film materials

In an environmentally sustainable future, it is important that the functionality of packaging materials is optimized. To be able to optimize their polymer film materials, Tetra Pak® used tensile testing combined with synchrotron small angle X-ray scattering to characterize the material properties during deformation, resulting in high-resolution data and new insights into optimization opportunities.

Understanding the irregularity of polymer structures

When producing thin polyethylene films in packaging material, the resulting polymer structures are unpredictable. The films are produced by rapidly cooling molten polymer at high flow speeds, and the quickly cooled molecules often turn out irregular.

To understand how this can be improved, Tetra Pak® wanted to study the extrusion-coated films undergoing mechanical stretching, using small angle X-ray scattering (SAXS). However, since the polymer films are very thin, the scattering intensity and time resolution of laboratory-based SAXS would not be enough. Instead, Tetra Pak® decided to combine tensile testing with synchrotron SAXS measurements.

Synchrotron X-rays cast light on polymer morphology

With help from Research Institutes of Sweden (RISE), the project was set up at Petra III synchrotron in Hamburg, and performed in collaboration with a team from Niels Bohr Institute and the local Petra III staff Dr. Matthias Schwartzkopf and Prof. Stephan Roth.

Using an in-situ tensile stress testing apparatus, samples were studied in the Petra III beamline. Measurements were performed with real-time resolution during mechanical stretching.

Enabling future optimization and sustainability of more polymer materials

The experiment generated high-resolution data on the stretching process in real-time, as well as the relaxation processes, with a time resolution of 1 s. Tetra Pak® was able to correlate differences in the properties of the polymer films during deformation to differences in their structures.

The characterization techniques used in this case will be important for optimizing package functionality in any polymer material. Soon, the techniques will also be available at MAX IV in Lund.

– With the developed methodology, we can characterize and compare morphology, structure and material orientation after manufacturing and during mechanical deformation of thin extrusion coated polymer films, says Anna Svensson, technology specialist at Tetra Pak®.

Interested in using the MAX IV facility for your research project? Please contact the Industrial Relations Team: +46 725 546 309 or visit www.maxess.se.

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